# CHEMICALS
Project Fact Sheet

# P-Xylene Production with Waste Heat Powered Ammonia Absorption Refrigeration

## Benefits

- Decreases capital costs
- Allows for economical delivery of p-Xylene to international markets
- Improves competitiveness of the pX crystallization process
- Reduces indirect $CO_2$ emissions
- Electricity savings of 30 to 40 percent

## Applications

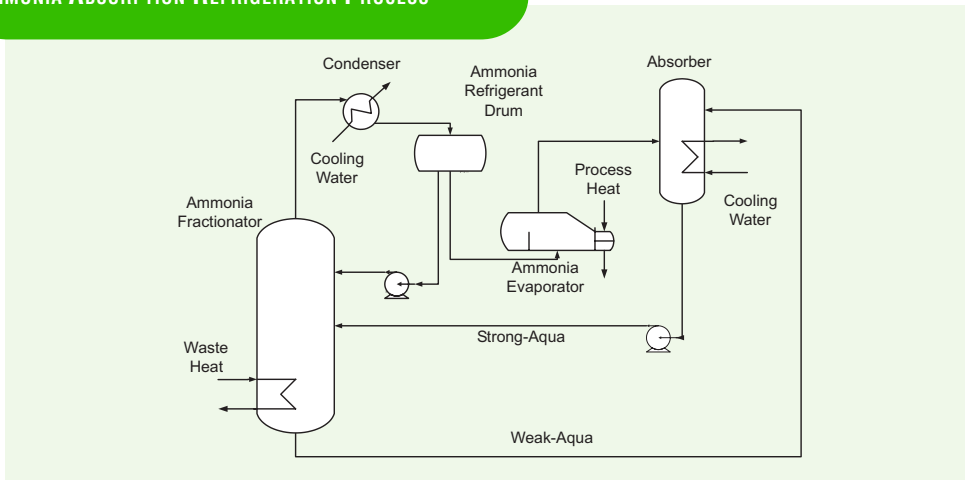
Ammonia absorption refrigeration could increase the cost effectiveness of the production of p-Xylene. P-Xylene is an intermediate in the production of polyester. There are many different applications for polyester, such as in the clothing, film, bottles, and tire cord industries.

## Ammonia Absorption Refrigeration Could Improve the Production Process for P-Xylene

For the industrial chemicals industry, ammonia absorption refrigeration (AAR) promises to be a cost-effective energy saving process for the production of p-Xylene (pX). P-Xylene is a commodity chemical commonly oxidized to terephthalic acid and purified to produce purified terephthalic acid (PTA), an intermediate in the manufacture of polyester. In 2001, the total world installed capacity of p-Xylene was approximately 21 MMTA (million metric tons per annum), and 4.3 MMTA U.S. Two competitive processes are used to recover pX, low temperature crystallization, and selective adsorption on a molecular sieve. In the production of pX by crystallization, approximately 60 percent of the total electricity consumed is used to run the refrigeration compressors. The refrigeration system typically uses cascaded ethylene and propane or propylene refrigeration loops. AAR can replace the propane or propylene loop, leading to savings of approximately 37 percent of the total electricity use or 19 percent of the total energy cost.

AAR converts waste heat into high-value refrigeration duty. Its application in the pX production process will result in reduced electricity consumption and lower indirect $CO_2$ emissions associated with electricity generation. AAR requires two units of heat input per one unit of refrigeration duty. However, the heat source for AAR is free, in that low temperature waste heat that would otherwise be lost is used. The use of this waste heat will reduce electricity consumption of pX units by 30 to 40 percent, depending on the feedstock and the pX recovery process. For a 400 KMTA (thousand metric tons per annum) pX unit, electricity savings are estimated at 4.5 megawatts, while reductions in indirect $CO_2$ emissions are estimated at 41 KMTA.

### Ammonia Absorption Refrigeration Process




**Ammonia absorption refrigeration conceptual flow diagram.**

## Project Description

**Goal:** To implement ammonia absorption refrigeration in the production of p-Xylene.

AAR operates with high and low pressure regions, and vapor and liquid regimes. Refrigeration is accomplished by evaporating ammonia at low pressure. The pressure determines the temperature, which can drop to as low as -45 ºC. This temperature is low enough to be applied successfully in the pX processes.

In the p-Xylene production process, AAR is suitable for the crystallization of p-Xylene and ethylene condensation. Ethylene is used to cool crystallizers, and in current pX processes, is condensed by heat exchange with other refrigerants, such as boiling propane or propylene.

The Program will also identify processes other than p-Xylene manufacturing that might benefit from AAR.

## Progress and Milestones

For success, the project must pass gate reviews at the end of each stage before passing to the next stage. The five stages are summarized below:

- Determine the technical feasibility and economic incentive with minimal effort
- Develop optimal designs for recovery of pX and select one best alternative
- Start engineering of commercial unit
- Execute phase (detailed engineering, procurement, and plant construction)
- Operate phase

## Commercialization

A successful project in the creation of an economically attractive pX process would be followed by commercialization via BP or a BP joint venture. It could be made available to other pX producers via licenses.

### Project Partners

BP Amoco Chemical Company
Naperville, IL

Energy Concepts Company
Annapolis, MD

Fluor Daniel
Greenville, SC

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